LA-UR-03-8545

Approved for public release;
distribution is unlimited.

Title:	DOE Nuclear Criticality Safety Program (NCSP) Review
Author(s):	Steven D. Clement and David K. Hayes
Submitted to:	The Nuclear Criticality Safety Program

Form 836 (8/00)

DOE Nuclear Criticality Safety Program (NCSP) Review

2003 ANS/ENS International Winter Meeting

Integral Experiments Program Element

New Orleans, LA
November 21, 2003

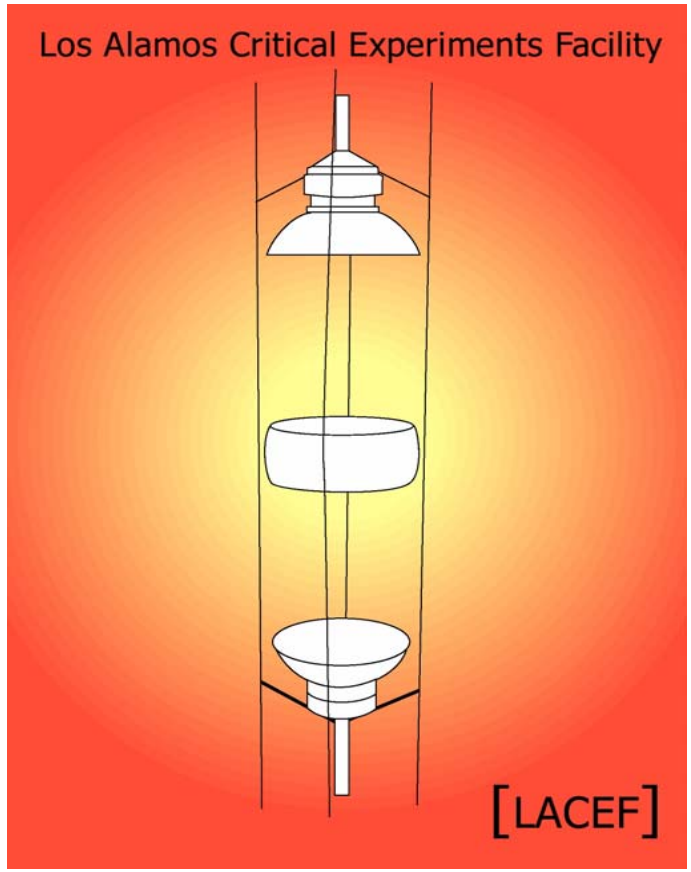
Steven D. Clement
David K. Hayes
Advanced Nuclear Technology, N-2

National Nuclear Security Administration

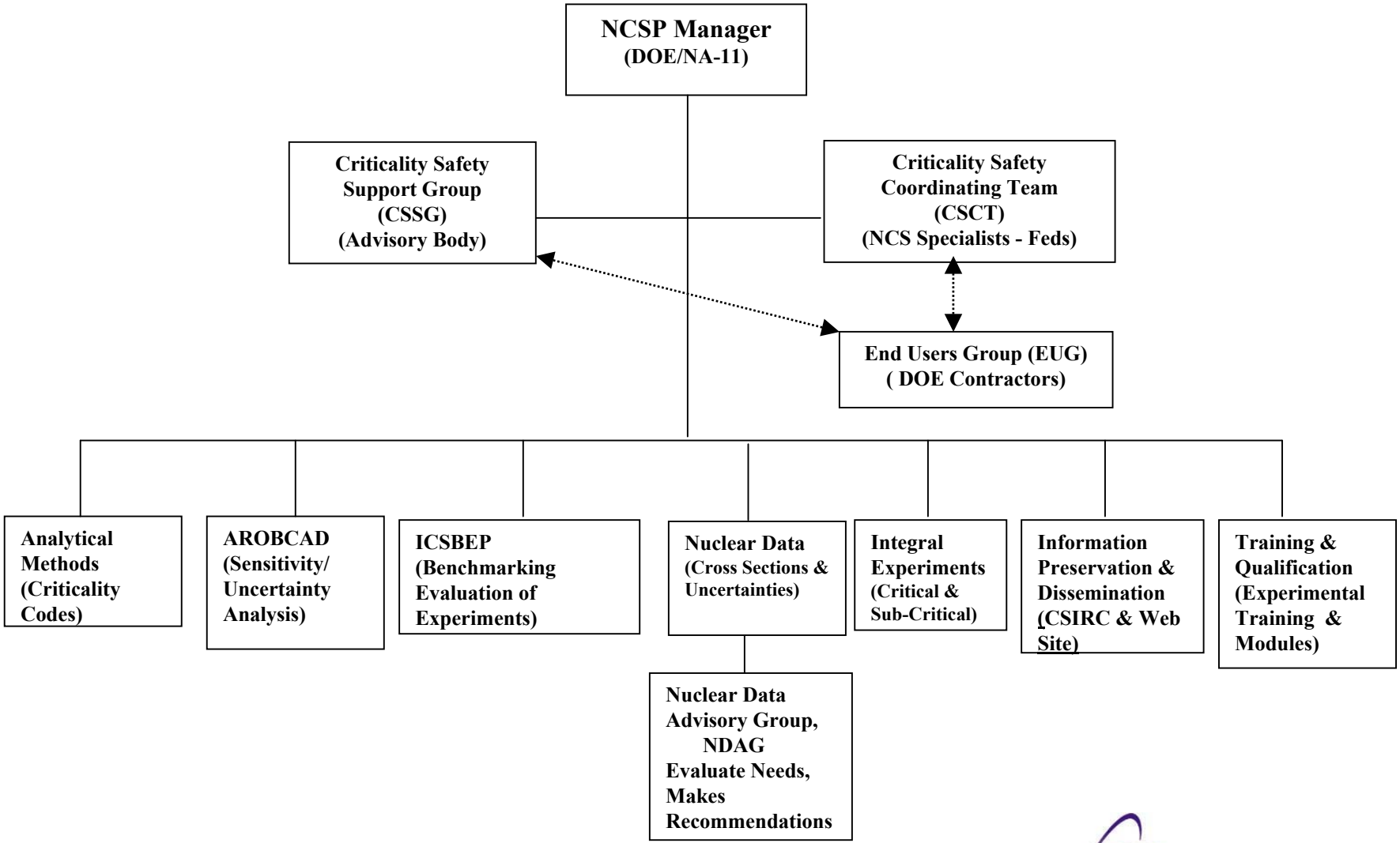
Los Alamos NATIONAL LABORATORY

Outline

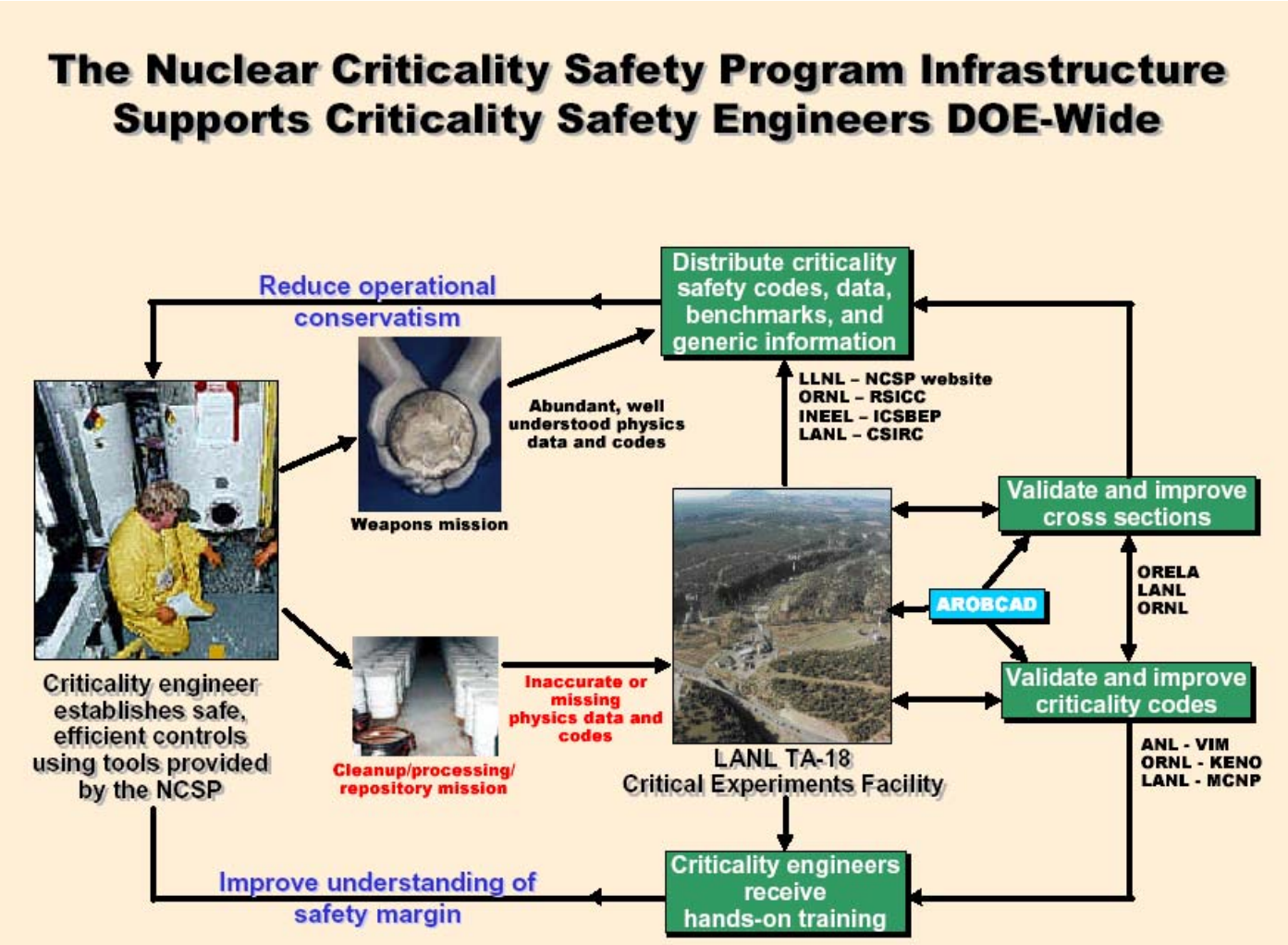
- **Integral Experiments Program Element within the NCSP**
- **Operational Status of LACEF**
- **FY03 Accomplishments**
  - Completed experiments
  - Completed benchmark evaluations
- **Plans for FY04**
  - Planned experiments
  - Planned benchmark evaluations
- **Other significant events/impacts**
  - Update on TA-18 mission relocation



Organization of the DOE/NNSA NCSP

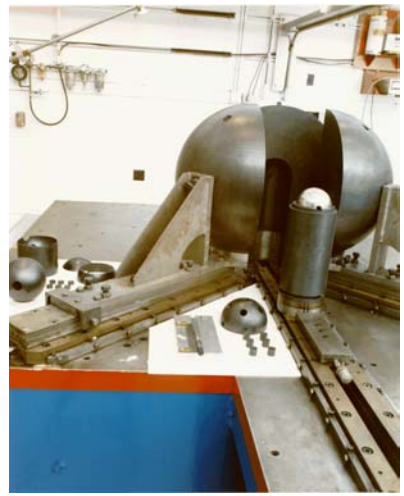


Organization of the DOE/NNSA NCSP (continued)



Current Critical Assembly Machine Status

- **Godiva IV** — Operable
- **Flattop** — Operable
- **Comet** — Operable
- **Planet** — Operable
- **SHEBA** — Operable



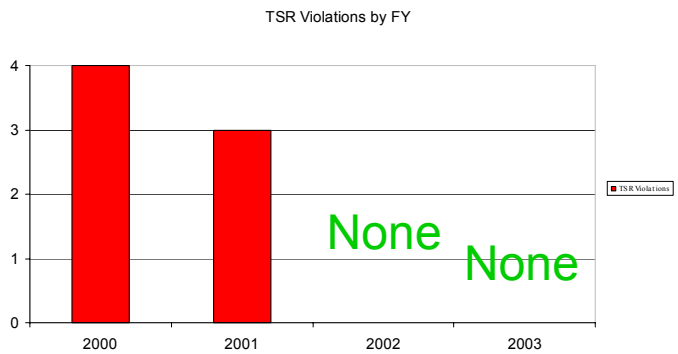
Significant Events of the Past Year
August 2002 – September 2003

- **Implementation of new Documented Safety Analysis (DSA)**
  - Basis for Interim Operation (BIO)
  - Technical Safety Requirements (TSRs)
  - Safety Evaluation Report (SER) Compensatory Measures (CMs)
  - Implementation Plan (IP) CMs
    - Multi-year, multi-million dollar safety basis upgrade effort
    - Represents a MAJOR change in the way we operate
- **Completion of Benchmarks**
  - Six committed to the NCSP – all six completed
- **Completion of all criticality safety classes**

Significant Events of the Past Year
August 2003 – September 2003

- **Significant new interest in performing experiments on Godiva from weapons programs and intelligence programs**

- **No TSR violations**
  - Only 1 reportable occurrence
    - AB violation of CM for checking for hydraulic leaks
      - Two checks required – only one check documented



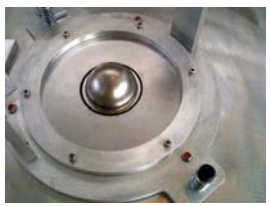
FY03 Accomplishments

- **Experiments proposed for this FY in the 5-Year Plan**

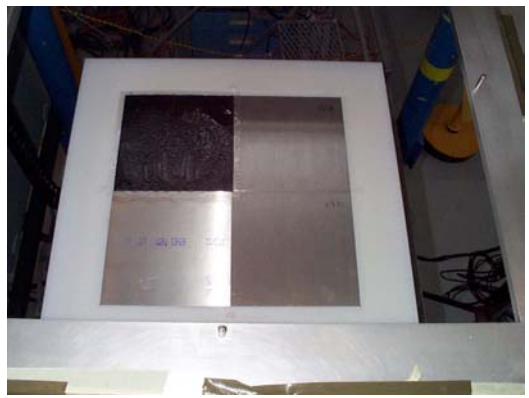
		Status
— Z005	Comet/Zeus, Fe^2/HEU/Fe^2	— Completed
— Z006	Comet/Zeus, Fe^3/HEU/Fe^3	— Terminated due to funding shortfall
— Z007	Comet/Zeus, Al^1/HEU/Al^1	— Moved to FY04
— Z008	Comet/Zeus, Al^2/HEU/AL^2	— Moved to FY04
— NP001	^{237}Np/HEU bare	— Completed
— NP002	^{237}Np/HEU/NU reflected	— Terminated due to funding shortfall
— P007	1x1 HEU/Fe/Poly	— Completed
— P008	2x2 HEU/Fe/Poly	— Completed
— P009	2x2 HEU/MgO/Poly	— Not performed – not enough foils to go critical
— SM1	HEU/Graphite	— Terminated due to funding shortfall
— SM2	HEU/D_2O	— Moved to FY04
— SUB1	Poly-Reflected Alpha-Phase Pu	— Completed

Additional Experiments Added to FY03

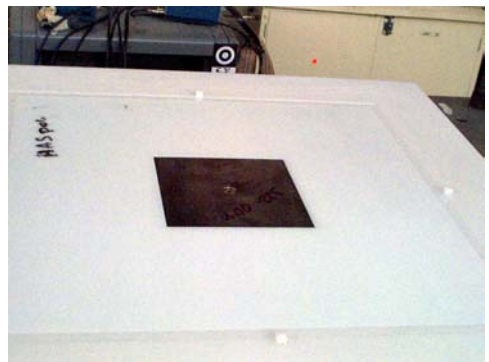
- 2x2 HEU/Al/Poly (now designated as P009)
- 2x2 HEU/Gd Alloy/Poly (now designated as P010)
- Pu (α) BRP Ball/HEU (now designated as P011)



BRP Ball – in holding fixture and on Planet

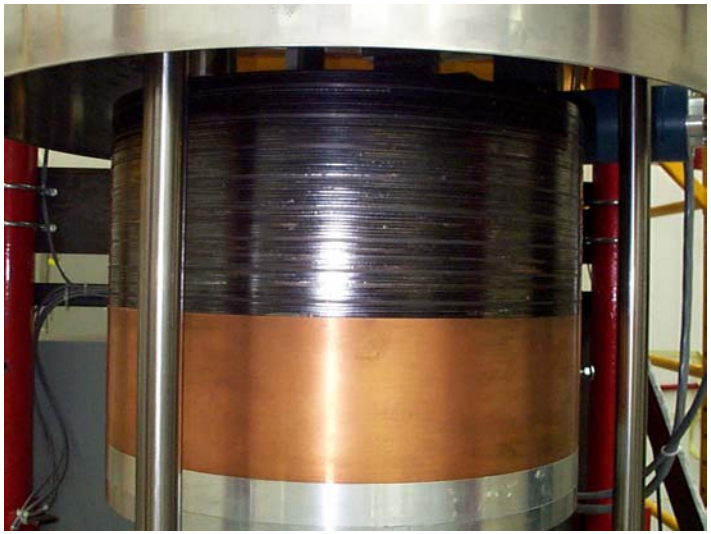


2x2 Aluminum in Poly



Gd Alloy sitting in Poly insert. Four HEU foils sit on top of the Poly insert.

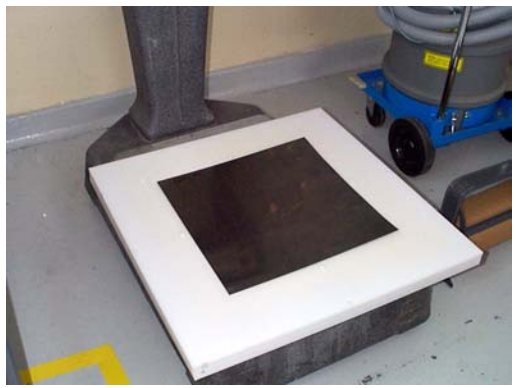
Some of What Was Accomplished in FY03



Zeus Fe Core

^{237}Np/HEU on Planet

Proud Parents



Iron (Fe) Plate in Poly

ICSBEP Benchmark Evaluations Committed to in FY03

- **Committed to in FY03**
  - SUB-PU-MET-FAST-001 — Polyethylene-Reflected Alpha Phase Plutonium Ball
  - HEU-MET-INTER-009 — Zeus Iron (Fe) Core
  - HEU-MET-THERM-012 — HEU/Al/Poly (2x2)
  - HEU-MET-THERM-013 — HEU/Fe/Poly (1x1, 0.015-inch thick and 0.0625-inch thick)
  - HEU-MET-THERM-014 — HEU/SiO_2/Poly (2x2)
  - SPEC-MET-FAST-008 — ^{237}Np/HEU bare

- **As Renegotiated on 1/29/03**
  - SUB-PU-MET-FAST-001 — SUB1, Poly-Reflected Alpha Phase Plutonium Ball
  - HEU-MET- INTER-009 — Z004, Zeus Iron (Fe) Core (Became HEU-MET-FAST-072)
  - HEU-MET-THERM-013 — P007, HEU/Fe/Poly (1x1, 0.015-inch thick and 0.0625-inch thick)
  - HEU-MET-THERM-014 — P006, HEU/SiO_2/Poly (2x2)
  - HEU-MET-THERM-016 — P010, HEU/Gd Alloy/Poly
  - SPEC-MET-FAST-008 — NP001, ^{237}Np/HEU bare

    - **HEU-MET-THERM-012 moved to FY04**
    - **HEU-MET-THERM-016 added to FY03**

- **As of the end of September 2003, all ICSBEP evaluation commitments have been submitted for external review**

LACEF Input to the NCSP 5-Year Plan

FY 2002 ($k) 1250	FY 2003 ($k) 1300 (actual was $700k)	FY 2004 ($k) 1372	FY 2005 ($k) 1400	FY 2006 ($k) 1450	FY 2007 ($k) 1700
NP001 ^{237}Np critical mass experiment Np/HEU (bare)	NP001 Continue ^{237}Np critical mass experiment Np/HEU bare	NP002 Continue ^{237}Np critical mass experiment Np/HEU/NU reflected	NP004 Np/HEU/Poly	P019 Pu(δ)/HEU	NP005 Np/HEU/Be
P001 1x1 HEU/MgO/Poly	NP002 moved to FY04	NP003 Np/HEU/Be	P016 2x2 Concrete/HEU/Poly	P020 1x1 Pu/SiO_2/Poly	NP006 Np/HEU/W
P002 1x1 HEU/Poly	P007 1x1 HEU/Fe/Poly	NP007 Np/HEU/Steel	P017 1x1 HEU/Al_2O_3/Poly	P021 1x1 Pu/Al/Poly	P022 2x2 Pu/SiO_2/Poly
P003 1x1 HEU/Gd/Poly	P008 2x2 HEU/Fe/Poly	P012 1x1 HEU/CaO/Poly	P018 2x2 HEU/Al_2O_3/Poly	SM5 Pu Reflected D_2O	P023 2x2 Pu/Al/Poly
P004 2x2 HEU/Poly	P009 2x2 HEU/AlPoly	P013 1x1 HEU/Zr/Poly	SM2 HEU/D_2O	Z010 Initiate ^{239}Pu intermediate energy experiment (if ^{239}Pu available) Graphite[1]/Pu/Graphite[1]	Z016 SiO_2[2]/Pu/SiO_2[2]
P005 2x2 HEU/Gd/Poly	P010 2x2 HEU/Gd Alloy/Poly	P014 Component Benchmark	SM3 HEU/Be	Z011 Graphite[2]/Pu/Graphite[2]	Z017 SiO_2[3]/Pu/SiO_2[3]
P006 2x2 HEU/Si/Poly	P011 Pu (α) BRP Ball/HEU	P015 1x1 Concrete/HEU/Poly	SM4 Pu Reflected Graphite	Z012 Initiate ^{233}U intermediate energy experiment (if ^{233}U available)	Z018 Fe[1]/Pu/Fe[1]
Z001 Comet/Zeus, 2 cm Graphite/HEU/2cm Graphite	SM1 moved to FY04	SM1 HEU/Graphite	SM6 Pu Reflected Be	Z014 SiO_2[2]/HEU/SiO_2[2]	
Z002 Comet/Zeus, 1 cm Graphite/HEU/1 cm Graphite	SUB1 Pu(α)/Poly Reflected	SUB2 ^{237}Np Bare and Reflected by Cu and HEU	Z008 Comet/Zeus, Al[2]/HEU/Al[2]	Z015 SiO_2[1]/Pu/SiO_2[1]	
Z003 Comet/Zeus, all HEU	Z005 Comet/Zeus, Fe[2]/HEU/Fe[2]	Z006 Comet/Zeus, Fe[3]/HEU/Fe[3]	Z009 HEU/Gd Alloy (if Gd Alloy becomes available)		
Z004 Fe[1]/HEU/Fe[1] (initial configuration)	Z006 moved to FY04	Z007 Comet/Zeus, Al[1]/HEU/Al[1]	Z013 SiO_2[1]/HEU/SiO_2[1]		

Completed
Initiated/ongoing
Experiments that will require a change to the AB and nuclear materials not currently available at Los Alamos.
Additional capital funding will be required.

National Nuclear Security Administration

Los Alamos NATIONAL LABORATORY

LACEF Input to the NCSP 5-Year Plan

FY 2008 ($k) 1800	FY2009 ($k) 2000	FY2010 ($k) 2200
P024 1x1 Pu/MgO/Poly	P029 HEU Reflected Poly	
P025 2x2 Pu/MgO/Poly	P030 HEU Reflected Steel	
P026 HEU bare	P031 HEU Reflected Be	
P027 HEU Reflected NU		
P028 HEU Reflected W		
Z019 $Fe^2/Pu/Fe^2$		
Z020 $Fe^3/Pu/Fe^3$		

Completed
Initiated/ongoing
Experiments that will require a change to the AB and nuclear materials not currently available at Los Alamos.
Additional capital funding will be required.

Proposed ICSBEP Evaluations

ICSBEP FIVE-YEAR PLAN	
LOS ALAMOS NATIONAL LABORATORY	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
HEU-MET-INTER-011	SM1, Special Moderator HEU/Graphite
HEU-MET-FAST-072	Z004/Z005/Z006, ZEUS HEU Fast/Intermediate Energy Spectrum with Iron (Fe)
HEU-MET-THERM-012	P009, Planet Waste Matrix HEU/Al/Poly (2x2 array)
HEU-MET-THERM-015	P007/P008, Planet Waste Matrix HEU-Fe (2x2 array) 15-mil thick iron plates
SUB-SPEC-MET-FAST-001	SUB2, Bare and Cu-reflected Np-237 Spheres
FY-2005	
SPEC-MET-FAST-009	NP001/NP002 Neptunium/HEU Critical (natural uranium reflected)
HEU-MET-INTER-010	Z007/Z008 ZEUS (HEU) Intermediate Energy Spectrum with Aluminum (Al)
SPEC-MET-FAST-014	NP007, Neptunium/HEU Reflected with Steel
HEU-MET-THERM-017	P012, Waste Matrices HEU / Ca / Poly
HEU-MET-THERM-018	P015, Waste Matrices HEU / Concrete / Poly
MIX-MET-FAST-013	P011, Bare Pu(α) / HEU

Current List and Status of Priority Experiments

JUNE 1998 RECOMMENDATIONS FOR PRIORITY OF CRITICAL EXPERIMENTS

PRIORITY	1998 IDENTIFIER	1994 IDENTIFIER	EXPERIMENT DESCRIPTION	RELATIVE PRIORITY	RELATIVE COST	BENEFITS ACRUE TO	STATUS	
1	98-2, 98-4, 98-6, 98-14, 98-28	107, 502i, 603, 609	Intermediate energy spectrum (ZEUS)	HIGH	LOW	DP, EM, MD, RW	Active	
2	98-6, 98-14, 98-2, 98-4	102, 502a, 702, 502g, 303	Fast, intermediate, and thermal energy spectrum with fissile / fissionable material in waste matrices	HIGH	MEDIUM	EM, MD, RW	Active	
3	98-7	206, 207, 102 502a, 702	Reactivity and replacement measurements with SHEBA (CERES, ^{233}U, MOX, etc)	HIGH	LOW	RW, EM, NRC	On hold	
4	98-1	None	Component safety benchmark experiments	HIGH	MEDIUM	DP, DoD	Active	New for FY03
5	98-22, 98-3, 98-16, 98-21, 98-23	301, 503, 504	Criticality accident simulation/equipment and methodology qualification	MEDIUM	LOW	DP, EM, MD, RW	Active	New for FY03
6	98-8, 98-9, 98-10, 98-13, 98-18, 98-19	601, 605, 605a, 605b, 401	Critical mass measurements and neutron parameters for actinide isotopes	MEDIUM	MEDIUM	DP, EM, MD, RW	Active	
6a			Thermal and intermediate energy experiments with gadoliniated alloy and HEU				Active	New for FY03
7	98-8	None	Lattice experiments with MOX fuel pins	MEDIUM	MEDIUM	RW, MD, DP NRC		
8	98-11	707, 304	Special moderators, situations, & anomalies (Be, BeO, D_2O, etc)	MEDIUM	MEDIUM	EM, MD, RW, DP	Active	New for FY03
9	98-5, 98-20, 98-21	601, 301, 303	Static benchmark experiments in fissile solutions	HIGH	VERY HIGH	DP, EM		
10	98-27	505, 701	Source jerk, pulsed neutron measurements for subcritical systems	HIGH	MEDIUM	DP, EM, EH, RW, NRC	Active	

Update on TA-18 Mission Relocation

- **TA-18 mission relocation proceeding**
  - DAF is the new preferred alternative – ROD signed 12/02
  - 90% CDR – 2008 remains the target date for relocation of the TA-18 Cat I and Cat II missions
  - CD-1 expected in early 2004
  - Early move option killed by NA-10
  - Cat III and Cat IV missions to remain at LANL
  - SHEBA options study underway